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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

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THIS ISSUE

Lubrication in the Presence of Water

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Lubrication in the Presence of Water

A Discussion of Lubricant Characteristics and Typical Conditions of Operation

THE extent to which it may be necessary to maintain lubrication in the presence of water is becoming more and more evident as machinery such as the air tool, for example, is adapted to new usages. As a result, there has been extensive research on the part of the petroleum industry in an effort to develop lubricants of moisture-resisting characteristics, or lubricants which will emulsify to a sufficient extent to develop and maintain a positive lubricating film between the wearing surfaces involved.

Perhaps the earliest effort to counteract the washing effect of water was the development of compounded steam cylinder oils for the lubrication of steam cylinders where wet steam was employed. It is a fact known to every power plant operator that wherever moisture may be involved in steam, the washing action of the former will tend to rapidly impair any film of lubricant which may be present upon the cylinder walls, valves and valve seats. It was proved, however, that by adding in the neighborhood of six to ten per cent of animal oil, such as tallow or degras, that sufficient adhesiveness would be brought about to create a decidedly tenacious and moisture resisting lubricating film.

This idea has since been studied in the development of the highest grade of distillate lubricating oils for marine Diesel engine air compressor service, where condensation during standby may oftentimes lead to rusting and corrosion of the cylinder surfaces. Lard oil, in this case, has been used as the compounding and emulsifying medium in the lubricating oil.

The hydraulic accumulator, the deep well pump and the multitude of materials handling equipment operating out-of-doors, have all developed other phases of operation wherein it is absolutely essential to counteract the effects of water upon the lubricants used, as well as the wearing surfaces. As a result, it will be of distinct interest to discuss certain of the outstanding features of industrial machinery operation and the salient characteristics of the lubricants which should be used.

Essential Characteristics of Lubricants

In the selection of a lubricant for underwater service, it is important to remember that the characteristics be such as to insure positive adhesiveness and ample resistance to the washing-off effects of water. As a general rule, these characteristics are developed by the use of suitable animal oils or soaps which will tend to emulsify in the presence of water.

GREASES

In a grease, it is the soap content which must be studied. This latter must be non-

soluble; in other words, it must be of a lime or calcium base. Were a soda soap used, due to the fact that this is normally soluble in water, upon contact with this latter, the soap would be dissolved from the oil, rendering this in-

Courtesy of Lincoln Steel & Forge Company
Fig. 1—Illustrating pressure grease lubrication of mine car wheel bearings.

capable of maintaining effective lubrication, especially if there is any possibility of it being washed out from between the bearing elements.

It is also important to remember that wherever water conditions may prevail there will be the possibility of comparatively low temperatures developing, especially on materials handling equipment in the coal mine or where pneumatic tools are involved. As a result, the oil content of any grease to be used for such service should have as low a pour test as possible.

Pour Test Determination

The fact that the pour test is one of the most important characteristics of any oil which is to be used for the lubrication of machinery in cold weather renders a brief description advisable due to the confusion that may frequently arise in this regard, and the methods of test which are employed.

Take the so-called "cold test" for example. This has been regarded variously as that temperature at which an oil loses its fluidity, or the temperature at which solid matter commences to separate. The fact that this latter pertains directly to paraffin base oils renders this term more or less irrelevant in respect to naphthenic or mixed base lubricants. Yet, it is these latter which are most directly applicable to cold weather lubrication.

In the case of paraffin base oils the "cloud test" as generally known today, is that temperature at which solid paraffin wax commences to crystallize out or separate from solution when the oil is chilled under the conditions specified for this method of test.

Were this test to be applied to a naphthenic base oil we would be dealing with that temperature just above which fluidity practically ceases. This temperature has with equal vagueness been variously termed the "melting point," "setting point" and "point of congealment."

Today, however, it is more generally known as the "pour test" where any other than paraffin base oils are being dealt with.

Manner of Handling

There has also been marked confusion in regard to methods of determining this temperature, and ignorance in regard to the factors

Courtesy of Industrial Brownhoist Corp.
Fig. 2—Underside view of a tractor showing exposed gears and tractor elements which may come into direct contact with water.

which may have influence upon accurate determination. Especially is this true in regard to the preparation of the sample for test.

The effect of cold upon lubricating oils is not the same as upon simple fluids such as

water, alcohol, glycerin, benzine, etc. The latter have fixed and accurately ascertainable freezing points at which a complete change from the liquid to the solid state takes place, but lubricating oils which are mixtures of hydrocarbons of various melting points or freezing points behave like solutions, and frequently deposit some portion of their constituents before the whole mixture solidifies.

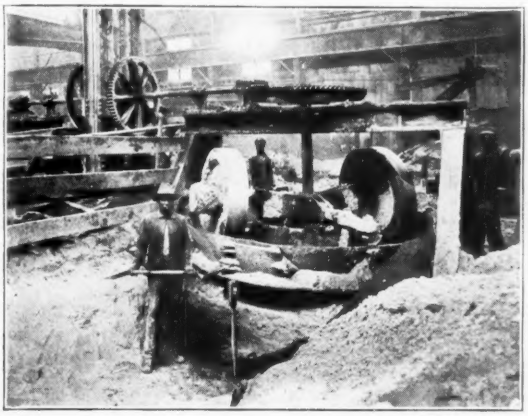


Fig. 3—Typical illustration of a grinding mill. Note the extent to which the driving gears and bearings are exposed.

Interesting phenomena which can only be explained by changes in the inner or molecular structures are observed in the pour test of many lubricating oils. If, for example, we take the pour test of an oil without previous heating and then take the pour test of the same oil after heating to 120 degrees Fahr., after allowing it to cool to the same temperature as the first, the oil which is heated solidifies at a considerably higher temperature and the influence from preheating seems to be effective for a considerable time, at least for twenty-four hours. Heating to temperatures below 90 degrees Fahr. apparently has no influence.

Another factor which has an effect on the test is stirring the oil while cooling to determine the pour test. In case an oil is stirred it solidifies at a lower temperature than when held stationary. This may be explained on the assumption that the movement of the oil destroys the formation of a fine network of microscopic particles of paraffin or naphthenic bodies which are separating out.

This segregation gives the oil a certain support and thereby facilitates solidification. In an analogous way this explanation may apply to the influence of preheating; the waxy or asphaltic particles are probably transformed by warming, into a very strongly dispersed state from which it is possible to form a finer and thicker network than in the oil which has not been heated.

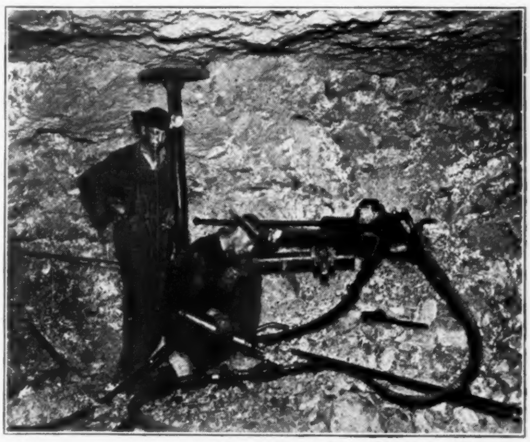
Numerous tests have been devised to determine the pour test of lubricating oils, each of which gives various and sundry results in the hands of different operators, due not only to ambiguity and lack of conciseness of the description of apparatus and method, but also in the application of the methods to oils for which they are adaptable.

Committee D-2 of the American Society for Testing Materials have taken considerable pains to work out a standard method for this determination. This method, while not new in principle, is more complete in detail than any previously published. It includes a precise definition of "cloud test" and "pour test" and classifies the oils to which each or both are applicable. Attention is therefore called to the report of this committee in event of the desire to study this matter of pour test in greater detail.

IN OILS

Where there is provision for oil lubrication on machinery subjected to water conditions, the oil must be studied from the viewpoint of its adhesive characteristics, as already stated, as well as its pour test. In oils for such service, the emulsifying constituent is normally an animal oil, although in marine service it is customary to use rapeseed oil to develop this same characteristic in marine engine oils.

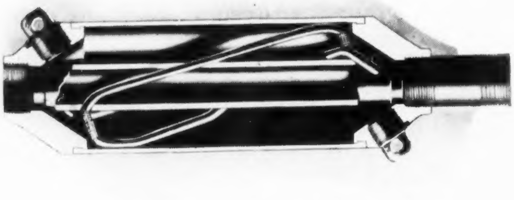
Animal and vegetable oils are commonly called fixed oils. They are adhesive to metal, incapable of distillation, and have the ability of uniting with water to form a tenacious lubricating film. In general, this latter will be comparatively permanent, whereas an emulsion which may be developed by a mineral oil alone, when agitated with water, will be more or less temporary, depending upon the degree of re-



Courtesy of Sullivan Machinery Company

Fig. 4—Mine drill operation showing an air line lubricator being filled with oil.

finement of the oil. It is inadvisable, however, to depend upon the emulsifying characteristics of a mineral oil alone, hence, the custom of adding a few percent of fixed oil to render emulsification more positive.



Courtesy of Ingersoll-Rand Company

Fig. 5—Sectional assembly of the Ingersoll-Rand Type D lubricator. By means of this device, all parts of a drill can be kept properly lubricated under the most severe conditions of under-water operation.

The amount of such compound will, of course, depend upon the service involved. Where an oil is to be used for Diesel engine air compressor lubrication, approximately 3 percent of lard oil will suffice. For steam cylinder service, in turn, the percent of compound may range from 4 to 12 percent, or even higher. As a general rule, tallow or degras (wool oil) is used in such products. In brief, the amount and nature of the compound and the original viscosity of the mineral oil will depend upon the service to be ultimately performed.

Viscosity Also Requires Consideration

In regard to this latter, it is interesting to bring out that the viscosity must also be considered. Viscosity, however, will be a function of the operating temperature. In marine engine service, for example, where reciprocating engine bearings operate at comparatively normal temperatures, a viscosity of approximately 600 to 700 seconds Saybolt at 100 degrees Fahr. will suffice. Steam cylinder oils, on the other hand, will require a considerably higher viscosity ranging, as a rule, from 100 to 180 seconds Saybolt at 210 degrees Fahr. It is also interesting to note that a gear compound for use under water conditions should range in the neighborhood of 1000 to 2000 seconds Saybolt at 210 degrees Fahr. Here, however, it is a matter of the pressure which must be counteracted rather than temperature, although in steel mill service hot water will frequently be encountered. The pour test requirements for an oil for use under water conditions will be practically the same as a grease for such service. Attention, therefore, is drawn to the previous remarks dealing with this test.

Typical Instances of Lubrication in the Presence of Water

PNEUMATIC TOOLS

Water conditions in the operation of pneumatic tools will frequently impose a decided load upon the lubricants involved. In the case of rock drills and other pneumatic mining machinery, operating oftentimes at a considerable distance below ground, water may become a serious factor, even if the tools are designed for operating on dry air, for condensation may develop to a marked extent especially when the tools are not operating. Furthermore, there is a possibility that a considerable amount of water may surround the exterior part of the tools and air piping due to mine leakage.

It is also important to remember that frequently water is intentionally mixed with the air to be used in such tools to serve the purpose of washing cuttings from the drill hole, in much the same manner as a soluble oil solution washes metal cuttings away from the tool in the machine shop drill, etc.

The Function of Compounded Lubricants

It is for this reason that compounded lubricants, i.e., mineral oils containing more or less animal oil or soap in compound, are recommended for such equipment as hammer drills where operating more or less in the presence of water. Such lubricants, of course, function on the same principle as do steam cylinder oils. In other words, they emulsify with water by virtue of their fatty content, creating an adhesive emulsion which adequately resists the washing effects of water and sticks tenaciously to all wearing elements.

Such lubricants, however, are only recommended for air tools wherein water is intentionally mixed with the air or where it is more or less positively known that a certain amount of water may gain entry into the tool mechanisms during operation.

When pneumatic tools are designed to function dry, they should be absolutely dry,—that is, free from moisture as far as possible, for the usual lubrication recommendations for such equipment will specify straight mineral products. These, if properly refined and of the requisite viscosity, and pour test, will adequately withstand any slight washing effect that may develop due to condensation of moisture from

the compressed air as normally used. They will not, however, protect the wearing surfaces against any excessive wear as may occur if the tool is dropped in the mud or allowed to remain exposed to the elements for any length of time when not in use.

The ultimate result will, of course, be rusting and corrosion, with subsequent difficulty in operation, an inability on the part of the tool to perform its rated amount of work and a necessity for repair or replacement of parts.

In the wet type of tool, such as the hammer drill, water leakage must also be guarded against, for the operation of the tool may be thereby impaired. As a result, conditions in the cylinders of such tools are somewhat similar to those encountered in the cylinders of water pumps. It is important to remember in the case of mine tools, that this water may also frequently contain an appreciable percentage of acid which would increase the possibility of subsequent corrosion.

STEEL MILL SERVICE

Roll Drives

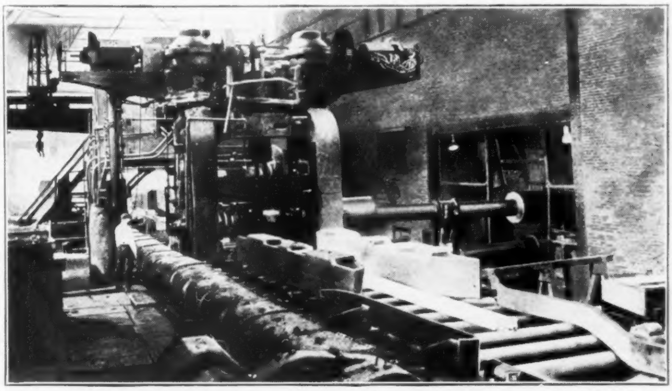
In steel plant service hot water or steam conditions will frequently prevail in the blooming mill as well as on certain other rolling machinery, for it is often found necessary to run water constantly over the rolls and roll necks for the dual purpose of cooling and blowing off scale which may be formed as the ingots, bars or billets are broken down.

Some mills, in addition, blow steam directly onto the ingot during its first pass through the rolls in order to more effectively remove the scale. Such conditions coupled with the extreme heat which is constantly encountered places a most exacting requirement upon the roll neck and gear lubricants. These must, therefore, be compounded products, inasmuch as straight mineral lubricants cannot withstand the continued washing action of hot water.

The usual procedure is to compound the gear lubricant with definite percentages of certain substances which will give the final product the desired adhesive properties. Any rolling mill gearing, however, which does not come in contact with water can readily be lubricated with a straight mineral gear compound of a viscosity ranging from 2000 to 5000 seconds Saybolt according to temperature conditions and the manner of lubrication.

Blooming Mill Pinions

The pinions adjacent to the roll necks in the blooming mill are usually enclosed in an oil-tight casing in which event they are run in a bath of specially prepared gear compound of high adhesive characteristics having a viscosity of about 2000 seconds Saybolt at 210 degrees Fahr.



Courtesy of Youngstown Sheet & Tube Co.

Fig. 6—Showing a typical condition of steel plant rolling mill operation.

In some installations, however, these pinions may be only covered with shields which are not oil tight. Where this is done there is often no bottom to the gear case; therefore, bath lubrication is out of the question. Hence the lubricant must be able to stick tenaciously to the pinions over the periods which intervene between its application, and maintain a sufficiently protective film. A viscosity of about 5000 seconds Saybolt at 210 degrees Fahr. has been found to be necessary in order that the resultant lubricating film will be able to withstand the terrific pounding and hammering which occurs, especially whenever the mill is reversed.

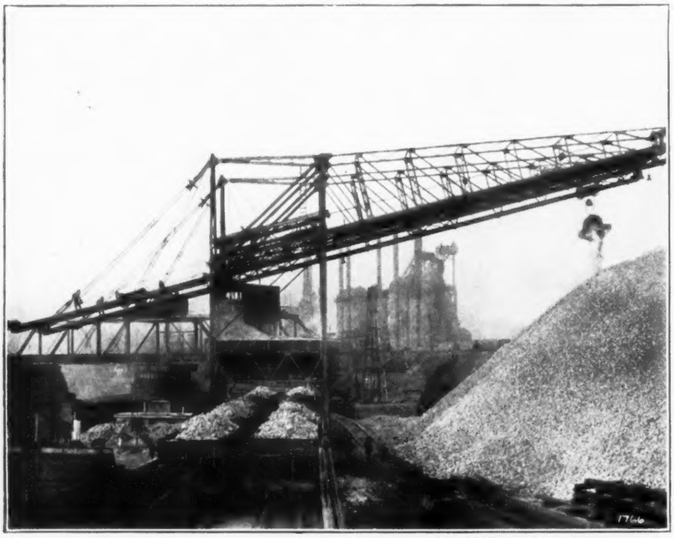
Continuous Mills

The rolls of continuous mills in turn are usually driven by herringbone pinions, and a set of relatively heavy gears. These pinions in such a mill are often so constructed as to make it necessary to lubricate the bearings with grease, and to maintain a continuous flow of cooling water over them.

Naturally this water will splash onto the pinions (where exposed), involving a condition and requiring a grade of lubricant as has been mentioned above in discussing the blooming mill. Certain mills, however, may be built with oil-tight gear cases and suitable shields which will permit of bath lubrication. This, of course, is the admirable condition, for the utmost of protection is afforded both the lubricant and the gear teeth.

Table Rollers

The bevel gears which drive the table rollers nearest to any type of rolling mill, frequently operate exposed. They are, therefore, subject to water conditions, flying scale and the heat which radiates from the hot metal in its course through the plant. Here the gear lubricant is difficult to apply, in the first place, and furthermore, after it has been applied, there is every obstacle put in the way of its functioning effectively. Centrifugal force will tend to throw it off, especially where it has suffered any extensive reduction in viscosity, due to overheating.



Courtesy of The Wellman-Seaver-Morgan Co.
Fig. 7—View of a limestone unloader showing the extent to which the wearing elements are exposed to the weather.

The washing action of the water which splashes over such gears is also a detriment. In addition, excessive contamination by solid foreign matter can hardly be avoided, unless precaution is taken to effectively guard such gears. Ultimate protection can only be attained, therefore, by frequent applications of a lubricant which has been so refined as to withstand these detrimental conditions.

Usually the same product as recommended for the blooming mill gears must be used, having a viscosity of from 1000 to 2000 seconds Saybolt at 210 degrees Fahr., according to weather and temperature conditions involved. It should be applied by pouring onto the teeth at the point of mesh while the gears are running inward.

Plate Mills

Plate mills present an additional detrimental condition due to the quantities of salt which are thrown on the plates during the process of rolling, and also the fact that the red hot plates pass directly over the bearings and gears of the table rollers. The purpose of salting is to remove the scale.

Oftentimes, water is also sprayed on the rolls in addition. These factors, coupled with flying scale and dust which is driven with considerable force when the hot gases explode, tend to destroy any lubricant used on the roll necks, table roller bearings and gears. Gear compounds as specified above, however, have been found to withstand these detrimental elements quite satisfactorily provided they are applied at frequent intervals and in sufficient quantities.

Here an additional property which the gear lubricant must possess is an ability to resist being thinned out by the oil which is used on the pinion bearings, inasmuch as a good deal of this latter will often work out and onto the gear teeth especially in older types of mills.

Roll Necks

Roll necks must be lubricated with a specially compounded roll neck grease that will not carbonize nor wash off when in contact with the water which is so often run over them to keep them cool. Lubricants used on such roll necks are termed cold neck greases. In general, they are tallow-mineral oil compounds, oftentimes being so prepared as to emulsify on contact with water. Frequently, however, water is not used or even where it is, the necks may run so hot as to melt down a cold neck grease. In such cases, a hot neck grease must be substituted even though added friction and wear may be developed.

PUMPING MACHINERY

Deep Well Pumps

The lubrication of deep well rotating shaft type pumping machinery is a problem in the irrigation and water works field, where water must be raised from a considerable depth. For this purpose vertical centrifugal pumps are often used.

Water is usually brought to the surface through a pipe within which the pump shaft is located. This shaft carries one or more impellers, according to the depth involved, the amount of water to be pumped, and the size of the well casing. It is the function of these impellers to raise the water at the requisite rate of discharge. Rotation is usually brought about by means of electric motor power. Due

to the speeds of operation, which may range from perhaps 700 to 1800 r.p.m., direct drive is possible, although belt connections are perfectly feasible and frequently more practical.

One of the essential lubricating problems on such pumps is to take care of the steady bearings in the cover pipe. These serve to center and hold the shaft in proper alignment, prevent deflection and maintain the requisite pressures with as vibrationless operation as possible. But only can these ideals be attained through the medium of effective lubrication. Essentially, the lubricant should be so constituted that it will

(1) maintain the requisite lubricating film;
(2) have as little tendency as possible to run out at the bottom of the pump from between the shaft and casing or cover pipe; and
(3) show as little internal friction as possible, for otherwise this would act as a brake on the impeller shaft.

Water can, of course, be used as a lubricant on such pumps, especially where a cover pipe is not employed. It is effective, economical, and prevents the possibility of contamination of the water being pumped.

Under certain conditions of sand, or the presence of other such fine particles of foreign matter in suspension, it is, however, generally considered better practice to provide for oil lubrication, installing a suitable cover pipe and bearings of design capable of bringing this about. Where water is the lubricant, these latter are oftentimes of rubber or hard wood.

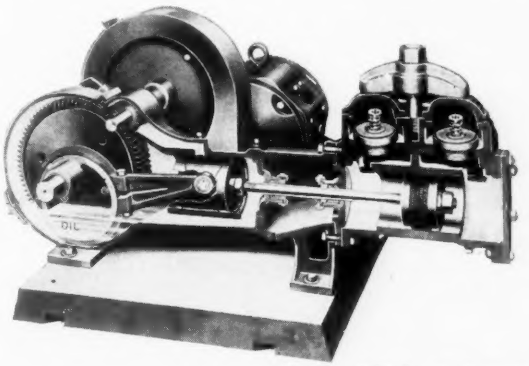
Bearing Design a Factor

Whatever the type of lubricant, however, the design and location of the bearings is a most important feature. Usually they must be located relatively close together. On certain pumps this distance is approximately eight feet.

Where lubrication by means of fluid oil is practicable, due to the high speeds involved, it will usually be best to use a comparatively low viscosity product. In general, a viscosity of from 180 to 200 seconds Saybolt at 100 degrees Fahr. will serve the purpose, providing that the stuffing box in the bottom of the cover pipe gives the requisite seal.

Under conditions of a marked difference in head, however, (especially where automatic circulation of the oil is not provided for) the oil might exert a pressure on the openings around the bottom bearings so much greater than would the water in the well (particularly when the pump is not operating) that this oil would run out at the bottom between the shaft and cover pipe, if the stuffing box happened to be worn to any extent.

This occurrence will be indicated by an excessive consumption of oil. The procedure in such a case would be to resort to a grade of liquid grease which will not only be capable of giving adequate lubrication with as low a drag as possible, but also will have sufficient body to



Courtesy of The Deming Company

Fig. 8—Phantom view of a double-acting piston mine pump showing the oil reservoir in the base of the crankcase. Where water conditions must be counteracted, a straight mineral steam cylinder oil has been found to be satisfactory.

resist the unbalanced pressure which may be involved.

As wear on the stuffing box increases, it may in turn be necessary to use a heavier grade of grease, though, of course, this may involve the sacrifice of a certain amount of mechanical efficiency. Such a grease should have a consistency very nearly the same as that of vaseline, and should be a product which will retain its plasticity at the approximate temperatures of pumping.

The adaptation of automatic balanced circulation lubrication, whereby oil is fed from a surface tank so located that oil and water pressures will be equalized is claimed to eliminate the possibility of waste and contamination of the well water. This oil is pumped through the bearings and back via a return pipe, by a suitable lubricant pump.

Such a system makes possible the continued usage of a fluid lubricant capable of giving the desired results with the least development of internal friction. Of course it requires the use of a suitable cover pipe, within which the shaft and steady bearings are located.

Here, the problem is much the same as involved with a turbine, excepting that the temperatures are lower. Therefore, oils of approximately the same viscosity as mentioned above should function satisfactorily.

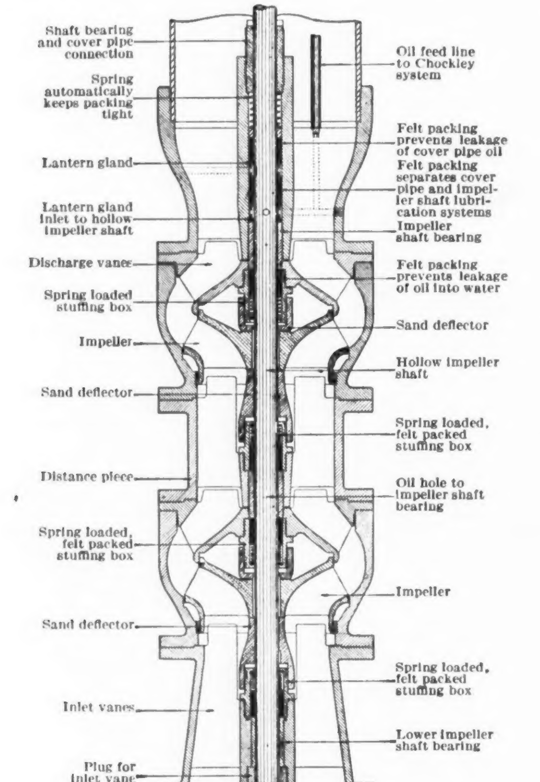
Mine Pumps

Another type of pump, the operation of which may often involve lubricating problems is the mine pump so necessary in the anthra-

cite coal fields, etc. Here water conditions may be very bad; therefore, it is necessary to employ the most rugged type of heavy duty pump to keep the sumps and galleries clear. For this purpose, naturally, many makes of pumps are used. In general, however, they will involve either the horizontal reciprocating steam or air-driven pump, the vertical motor-driven triplex pump or the centrifugal pump.

Bearings of Centrifugal Pumps

Where bearings alone are involved as in the motor-driven centrifugal pump, lubrication will be a relatively simple matter. Ring oilers predominate and these can usually be taken care of



Courtesy of Worthington Pump & Machinery Corporation

Fig. 9—View of the impeller shaft oiling system of a Worthington Deep Well Rotating Shaft Type Pump. All parts are clearly indicated.

by means of a medium body straight mineral engine oil of from 200 to 400 seconds Saybolt viscosity at 100 degrees Fahr. This same oil can also be used with satisfaction on the external bearings of reciprocating pumps.

In lieu of oil, however, certain builders will prefer grease due to the fact that frequently

Courtesy of The Jeffrey Manufacturing Company

Fig. 10—An electric mine locomotive in operation. Note nature of working conditions and the potential possibilities of impaired lubrication due to water.

there will be less chance for dust or dirt gaining entry to score or abrade the bearings. With either the compression or spring type of grease cup, a medium bodied cup grease will serve the desired purpose. It is furthermore of advantage wherever shaft ends are exposed, for a seal of grease will prevent the entry of dirt more readily than an oil film due to its higher consistency, and the degree to which it "stays put" in the bearing.

Plunger Lubrication

Where mine pumps are of the outside packed plunger type they require a lubricant which will keep the packing properly sealed and prevent excessive wear on the plungers.

A relatively high viscosity straight mineral lubricant will usually serve this purpose. Not only will such a product lubricate the plunger, but also it will seal the clearance space effectively and lubricate the packing so that there will be little or no danger of this being damaged. Another advantage of such a lubricant is that it will adequately protect the plunger from the corrosive effects of sulfurous compounds with which the mine water may be contaminated.

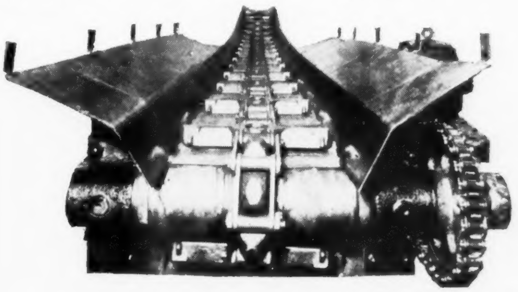
MATERIALS HANDLING EQUIPMENT

Wire Rope

Wire rope lubrication is one of the most important factors in any plant where materials in bulk such as ore, coke or coal are to be handled; for the ultimate efficiency of operation is, to a large extent, dependent upon the condition of the cables or wire ropes.

It can be easily realized that a rope with one or two broken strands due to rusting or wear traceable to improper lubrication, may not only cause a tie-up of the entire machine if such strands interfere with the operation of sheaves,

or other companion cables, but may also present a distinct hazard. Any wire rope in such condition is just that much weaker and less capable of handling the existing loads.



Courtesy of Link-Belt Company

Fig. 11—An underground coal conveyor looking down from the head end. The construction of the driving elements is clearly shown.

The Occurrence of Friction

It is not enough to assume that because such ropes come from the manufacturers in a lubricated state, being in general wound on an oil-saturated core, that further lubrication is unnecessary. Under operation there is constant friction and wear between the strands and a tendency to squeeze out any contained lubricant, especially when the ropes pass over sheaves or around drums. The renewal of this product is, therefore, an absolute necessity.

The matter of friction between the strands of a wire rope is essentially the same as friction between a bearing and a shaft. Overheating and abnormal wear will practically always result, to reduce the load carrying capacity and increase the amount of power consumed in operation. This can only be overcome by effective lubrication, brought about by the proper application of a suitably prepared wire rope compound, which will be capable of not only penetrating to the innermost strands and core of the rope, but also sufficiently adhesive and viscous to resist being prematurely squeezed out or washed off by rain or sleet.

Lubricant Characteristics

Essentially a wire rope lubricant, in addition to the properties mentioned above, must not tend to cake, gum or ball up, especially if contaminated with an excess of dust, dirt or metallic particles. Furthermore, it must be resistant to the thinning-down effects of higher temperature. This, of course, directly involves the viscosity or relative fluidity of the product. In fact, viscosity of such products is the essential characteristic involved in purchasing. It should not, however, be assumed as being the chief guide as to the actual suitability of a wire rope lubricant.

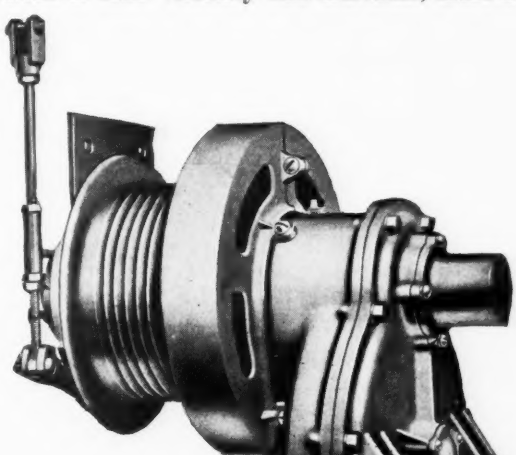
In this regard the ability of the latter to function, penetrate and stick under actual operating conditions, is of outstanding importance. In consequence, such products should not be purchased haphazardly, nor on a price basis alone. The potential difficulties that might result in cold weather are too serious.

Wire rope lubricants to meet the aforesaid requirements should, in general be straight mineral petroleum products, devoid of fillers or thickening mediums. In other words, whatever the viscosity, it should be an inherent property of the lubricant, not an artificial characteristic which cannot be depended upon.

It is for this reason that greases or soap thickened mineral oils are relatively unsuited to wire rope lubrication. To attain the requisite body a comparatively high percentage of soap would be necessary. Soap, of course, serves as the carrying medium for the oil. It has relatively no lubricating value, however; as a result, this property in the resultant product is decreased to a marked extent. Furthermore, the adhesive characteristic of greases is low. In consequence, such products will not, in general, meet the requirements of wire rope lubrication.

Application of Wire Rope Lubricants

As a general rule wire rope lubricants, by virtue of their viscosity and inertness, must be



Courtesy of Economy Engineering Company

Fig. 12—An electric hoisting unit showing in particular the manner of housing to prevent entry of water and possible impairment of lubrication.

applied in heated condition. To merely attempt to daub or paint a rope with such a product at normal temperatures would be relatively ineffectual. Even though the surface

might be more or less coated, the possibility of penetration occurring to any extent would be remote. This latter is the secret of effective wire rope lubrication. The amount of wear occurring between the exterior of such a rope

Courtesy of Harnischfeger Sales Corporation

Fig. 13—Power shovel operation involves exposure to the weather. Note in this case the amount of wire rope employed and the extent to which all other operating parts may have to be lubricated in the presence of water.

and the sheaves is not as marked as that which occurs between adjacent strands when the rope is flexed or bent as in passing over sheaves or hoisting drums. On the other hand, bending promotes penetration of the lubricant.

A very satisfactory method of treating wire ropes is to use a form of split box through which the rope can be run. Such a box can be readily built in the average plant, with suitable provision for rendering it sufficiently tight to prevent the lubricant from leaking out, even when reduced in viscosity by heating. The slow passage of the rope through such a bath of heated compound will insure that not only will the surface be coated, but also that the requisite penetration takes place on the inner strands. Further slow working of the rope over the sheaves before the lubricant has time to cool completely will tend to aid in bringing about the maximum of penetration.

HYDRAULIC EQUIPMENT

The hydraulic elevator and the hydraulic accumulator are examples of the use of water power for the conservation and transformation of energy. The earlier types of elevators employed in building construction were frequently of the hydraulic type. Even today the same principles are employed in the construction of certain types of sidewalk hoists.

The hydraulic accumulator, as it is termed in the steel industry, serves more or less the same purpose as a fly-wheel, in that it is used to accumulate energy for subsequent usage in operating the doors of the soaking pits or for certain types of shears, for example.

The mechanism of the accumulator involves a suitable storage tank capable of retaining water under the pressure involved. By means of control valves, the power contained therein can be made to act upon a heavily weighted plunger, via its retaining cylinder. The principles of operation are much the same as those of the hydraulic elevator.

Media Employed

While the term "hydraulic" implies the use of water, it has been developed that light oils can be employed with excellent results as, for example, in the case of the marine telemotor and in the operation of certain types of hydraulic presses. For the purpose of this

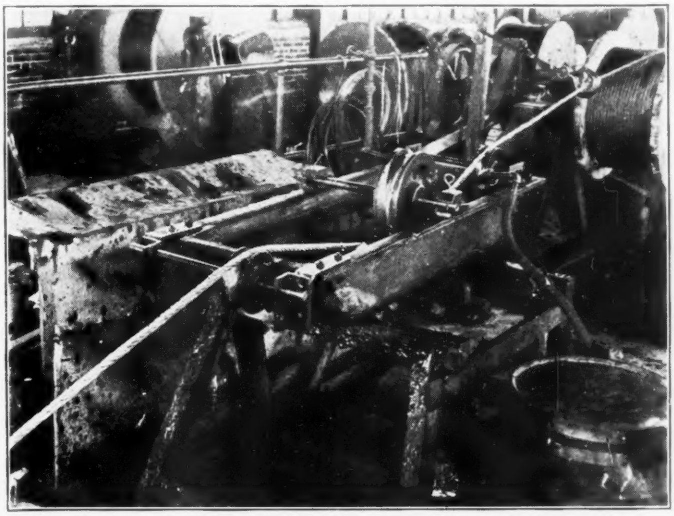
Courtesy of Manning, Maxwell & Moore, Inc.

Fig. 14—Showing a method of protecting wire rope while bending around sheaves. This will aid the lubricant to penetrate to the interior strands and more effectively prevent entry of water.

article, however, we are more specifically interested in those cases where water is used.

The extent to which lubrication is involved is confined to the plungers and piston rods. The purpose is to maintain the leather cups of

the control valves in a soft, pliable condition and preventing too rapid deterioration of the packing. In a closed system this may be accomplished by adding an emulsifying compound to the water. By use of a compound,



Courtesy of Williamsport Wire Rope Company

Fig. 15—Illustrating a means of treating wire rope with preservative lubrication prior to winding.

such as soluble oil, precipitation of any fine grit or impurities which may be held in suspension is also brought about, to thus prevent possibility of excessive wear on the moving parts with which water must come in contact.

An effective method of lubricating plungers, especially in the steel industry, to prevent scoring, preserve the packing and reduce water leakage, involves the use of sight feed oil cups. A satisfactory lubricant can be developed by mixing a light gear compound with steam cylinder oil.

STEAM CYLINDER LUBRICATION

From the viewpoint of the actual composition of a cylinder oil, the question of moisture in the steam is the most important factor involved.

Steam will always contain a certain percentage of moisture unless it is superheated to a sufficient extent to counteract any line and cylinder condensation which may be caused by the cooling effect of the piping or cylinder walls, and the expenditure of heat by the expansion stroke.

The presence of moisture in steam will usually result in a film of straight mineral lubricating oil being rapidly washed off from the cylinder walls and other surfaces with which the steam comes in contact. Therefore, to secure proper lubrication under wet steam conditions it is necessary to either increase the rate of flow of a straight mineral oil or else substitute an oil which contains a certain percentage of fatty compound, such as degras or tallow.

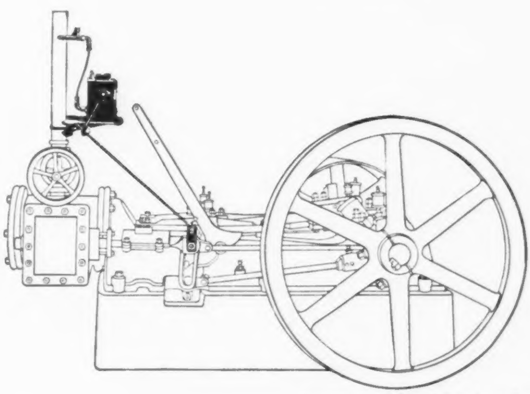
When to Use Straight Mineral Oils

The practice of using a straight mineral oil to lubricate wet steam is customary only where the presence of a fatty oil in the exhaust steam is objectionable. The increased amount necessary to insure proper lubrication will often result in imperfect atomization. As a consequence, oil accumulations in the cylinder will be prevalent and carbon deposits developed.

Especially will the above be true in multiple expansion engines equipped with receivers and reheaters, the high temperatures to which the oil is subject being very conducive to carbonization. In poppet valve engines carbon formation of this nature may often cause imperfect operation of the valves.

The Purpose of Compounding

Where a compounded oil is used adhesiveness is developed toward the metal, repelling the moisture in the steam from the cylinder wall. The lubricating film thus has a greater affinity for the cylinder walls and other wearing surfaces

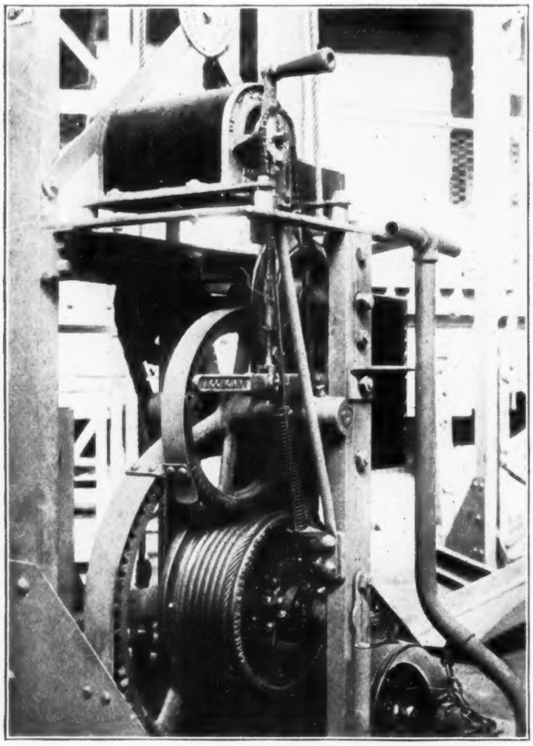


Courtesy of Manzel Brothers Co.

Fig. 16—A mechanical force feed oiler installed on a steam drilling engine. Where such machinery is operating out of doors, the degree of condensation may be high. The lubricator must, therefore, deliver a dependable and positive amount of oil to insure adequate cylinder lubrication.

and becomes highly resistant to the washing action of the water in the steam. Naturally the greater the percentage of moisture in the steam the higher should be the fatty compound content of the lubricant.

In general the compound should not exceed 10 percent, however, except in extreme cases of abnormally wet steam. We must remember that an excessive amount of fatty compound, beyond that necessary to form the requisite



Courtesy of Economy Engineering Company

Fig. 17—General details of an electric hoist. The exposed nature of the gears and rope require careful attention in selecting lubricants which will adequately resist the washing-off effects of water.

emulsion, will not improve the lubricating value of the oil. In fact, it may even be an objection, especially under continued exposure to high temperatures on account of the tendency that animal fats have of decomposing under such conditions.

Amount of Compounding

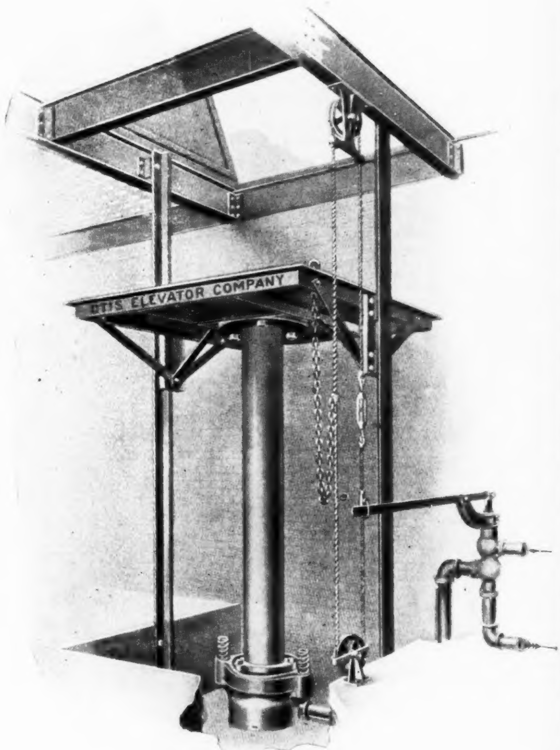
In regard to the proper amount of compound to use in an oil it can be said that this should be just sufficient to maintain a film of oil on the cylinder walls. This is especially true where the exhaust steam is to be used for feed water heating or in process work of any nature. Under such conditions it is more important than ever to observe caution in selecting and using steam cylinder lubricants.

Present day practice is to more and more reduce the quantity of compound and to improve its quality.

That tendency in compounded oils which causes them to unite with water to develop adhesiveness on the walls also prevents ready separation from water in condensed steam; furthermore, the more completely atomized the oil the more difficulty will it have in separating from water.

Oil in the form of fine emulsions in a boiler combines with the boiler compounds to cause foaming, or with the boiler impurities to produce a coating over the tubes and fire surfaces. This coating seems to form more readily over relatively clean tubes than over dirty ones.

A very thin layer of oily sludge over a tube



Courtesy of Otis Elevator Company

Fig. 18—View of a typical sidewalk elevator showing construction of plunger, the hydraulic piping connections and the stuffing box.

surface will so insulate it that there is not only a large loss in heat efficiency, but the rise in temperature of the metal may be so excessive as to cause burning out or explosion of the boiler.

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